

## WHAT IS CLAIMED IS:

1. A manufacturing method of a semiconductor device, which comprises depositing metal film including an aluminum over a semiconductor substrate, and etching the metal film with a plasma of a mixture gas containing a  $\text{Cl}_2$  gas, a  $\text{BCl}_3$  gas and a  $\text{CH}_2\text{Cl}_2$  gas.

2. A method of Claim 1, wherein the pressure of the mixture gas is not greater than 1.5 Pa but 0.6 Pa or greater.

3. A method of Claim 1, wherein the  $\text{CH}_2\text{Cl}_2$  gas has a purity of 99.99% or greater.

4. A method of Claim 1, wherein the plasma is generated using an electromagnetic wave within a frequency range of 300 MHz to 1 GHz.

5. A manufacturing method of a semiconductor device, which comprises forming a multilayer interconnection of metals including aluminum over a semiconductor substrate, wherein upon etching of the metal multilayer interconnection, a plasma of a mixture gas containing a  $\text{Cl}_2$  gas, a  $\text{BCl}_3$  gas and a  $\text{CH}_2\text{Cl}_2$  gas is used.

6. A method of Claim 5, wherein the pressure of the mixture gas is not greater than 1.5 Pa but 0.6 Pa or greater.

7. A method of Claim 5, wherein the  $\text{CH}_2\text{Cl}_2$  gas has a purity of 99.99% or greater.

8. A method of Claim 5, wherein the plasma is generated using an electromagnetic wave within a frequency range of 300

MHz to 1 GHz.

9. A manufacturing method of a semiconductor device, which comprises forming metal films by stacking a TiN film, an Al film and a TiN film successively over a semiconductor substrate, and  
5 etching the metal films with a plasma of a mixture gas of a Cl<sub>2</sub> gas, a BCl<sub>3</sub> gas and a CH<sub>2</sub>Cl<sub>2</sub> additive gas, wherein the CH<sub>2</sub>Cl<sub>2</sub> gas is added in an amount of 0 to 4% upon etching of the TiN film, whereas the amount of the CH<sub>2</sub>Cl<sub>2</sub> gas is increased to 5 to 30% during etching of the Al film.

10. A manufacturing method of a semiconductor device, which comprises depositing metal film including an aluminum over a semiconductor substrate, forming a resist mask over the metal film, etching the metal film with a plasma of a mixture gas of a Cl<sub>2</sub> gas, a BCl<sub>3</sub> gas and a CH<sub>2</sub>Cl<sub>2</sub> gas, and removing the resist  
15 mask with a plasma of a mixture gas containing an F element and an O element.

11. A manufacturing method of a semiconductor device, which comprises depositing metal film including an aluminum over a semiconductor substrate, forming patterns at a wiring pitch  
20 less than 500 nm over the metal film, and etching the metal film with a plasma of a mixture gas containing a Cl<sub>2</sub> gas, a BCl<sub>3</sub> gas and a CH<sub>2</sub>Cl<sub>2</sub> gas.

12. A manufacturing method of a semiconductor device, which comprises depositing metal film including an aluminum over  
25 a semiconductor substrate, forming, over the metal film, first

mask patterns at a first wiring pitch and second mask patterns at a second wiring pitch wider than the first wiring pitch, and etching the metal films with a plasma of a mixture gas containing a  $\text{Cl}_2$  gas, a  $\text{BCl}_3$  gas and a  $\text{CH}_2\text{Cl}_2$  gas.

5           13. A manufacturing method of a semiconductor device, which comprises depositing metal film including an aluminum over a semiconductor substrate, forming, over the metal film, first patterns at a first wiring pitch and second patterns at a second wiring pitch wider than the first wiring pitch, and etching the metal film with a plasma of a mixture gas containing a  $\text{Cl}_2$  gas,  
10           a  $\text{BCl}_3$  gas and a  $\text{CH}_2\text{Cl}_2$  gas.

          14. A manufacturing method of a semiconductor device, which comprises forming metal films over a semiconductor substrate by stacking a TiN film, an Al film and a TiN film one after another, and etching the metal films with a plasma of a  
15           mixture gas containing a  $\text{Cl}_2$  gas, a  $\text{BCl}_3$  gas and an additive gas obtained by diluting a  $\text{CH}_2\text{Cl}_2$  gas with a dilution gas, wherein the mole concentration of the  $\text{CH}_2\text{Cl}_2$  gas after dilution with the dilution gas is 10% to 100%.

20           15. A manufacturing method of a semiconductor device, which comprises depositing metal film including an aluminum over a semiconductor substrate, and etching the metal film with a plasma formed, in a plasma etching system for generating a plasma by using an UHF-range electromagnetic wave, from a mixture gas  
25           containing a  $\text{Cl}_2$  gas, a  $\text{BCl}_3$  gas and a  $\text{CH}_2\text{Cl}_2$  gas.